

LEXINGTON, Kc.
UNITED STATES SIGNAL SERVICE
MONTHLY WEATHER REVIEW.

VOL. XVII.

WASHINGTON CITY, JANUARY, 1889.

No. 1.

INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for January, 1889, and is based upon reports of regular and voluntary observers of both countries.

On chart i the paths of the centres of nine areas of low pressure are shown; the average number traced for January during the last fifteen years being 12.9.

The areas of high and low pressure and north Atlantic storms are discussed under their respective headings. The severest storms of the month occurred on the 9th, attending the passage of low area iii. Descriptions of the more destructive storms reported on that date, together with charts (vi and vii) exhibiting isobars, isotherms, and wind-directions over the United States and Canada at 8 a. m. and 8 p. m., 75th meridian time, are published in this issue of the REVIEW. Chart i also shows the approximate paths of the centres of eight depressions traced over the north Atlantic Ocean and the limits of fog-belts west of the fortieth meridian. The average number of depressions traced over the north Atlantic for January during the last six years is 10. No ocean ice was reported during the month.

Chart ii exhibits the distribution of mean atmospheric pressure and temperature for the month. The mean temperature was below the normal in the Rocky Mountain districts, at stations in southern and western Texas, and over eastern and southern Florida; the greatest deficiencies being shown in the middle plateau region, where they exceeded 10°. In all other districts the mean temperature was above the normal, the departures being most marked in the north-central part of the country, where they were more than 10°. At several stations in the northern districts the maximum temperature was higher than for any previous January during the periods of observation.

The distribution of precipitation for January 1889, is shown on chart iii, and the normal precipitation for eighteen years is exhibited on chart iv.

The precipitation was deficient on the north Pacific coast, in the northern portions of the plateau districts and eastern Rocky Mountain slope, over an area extending from Louisiana, Mississippi, and northern Alabama to the upper Ohio valley and Lake region, within a small area in the lower Missouri valley, and in portions of New England and the Maritime Provinces; elsewhere the precipitation was in excess of the average for the month. The current and normal precipitation at the various stations and in the several districts is treated in detail under the heading of "Precipitation." In the table

of excessive precipitation will be found a record of excessive monthly, daily, and hourly rainfalls for January, 1889. Under this heading there also appears a table giving the aggregate number of excessive monthly, daily, and hourly rainfalls for the several states and territories, as shown by the monthly and supplementary tables of excessive precipitation published in the MONTHLY WEATHER REVIEW during 1888.

Chart v exhibits the depth of snow on the ground at the close of the month, and its discussion appears under the heading of "Precipitation." This chart also shows the limits of freezing weather during January, 1889.

Two additional charts, based upon data contained in the annual summaries of regular and voluntary observers of the Signal Service for 1888, are published with this issue of the REVIEW. Chart viii exhibits annual mean isotherms, and departures from the normal temperatures, and chart ix shows the annual distribution of precipitation over the United States and Canada. These charts and data are discussed under the heading of "Annual Summary for 1888."

Commencing with July, 1888, the meteorological means for the regular stations of the Signal Service have been determined from observations taken twice daily at 8 a. m. and 8 p. m. (75th meridian time). These hours of observation have been permanently adopted to supersede the former system of tri-daily observations taken at eight-hour intervals. The monthly mean temperature for Signal Service stations represents the means of the maximum and minimum temperatures.

In the preparation of this REVIEW the following data, received to February 20, 1889, have been used: the regular semi-daily weather-charts, containing data of simultaneous observations taken at 133 Signal Service stations and 25 Canadian stations, as telegraphed to this office; 175 monthly journals and 177 monthly means from the former and 25 monthly means from the latter; 544 monthly registers from voluntary observers; 107 monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the Hydrographic Office, United States Navy, and the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New England, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, and Texas, and the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for January, 1889, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on chart ii by isobars. On July 1, 1888, the tri-daily observations of the Signal Service were superseded by observations taken twice

daily at the hours named. A protracted series of hourly observations has shown that the difference is almost inappreciable between the mean pressure obtained from two observations taken at these hours and that determined from tri-daily observations taken at eight-hour intervals.

The mean pressure for January, 1889, was highest over the middle and northern plateau regions of the Rocky Mountains, where it rose above 30.25, the highest reading, 30.31, being noted at Fort Du Chesne, Utah. From this region there was a marked decrease in mean pressure westward to the Pacific coast, where it fell below 30.10, and a very gradual decrease eastward to the Canadian Maritime Provinces, where the values were below 29.95, the lowest reading reported, 29.94, being noted at Sydney, C. B. I. Along the extreme southern border of the United States the mean pressure fell below 30.10, except in the lower Rio Grande Valley, near Rio Grande City, Tex., where a reading of 30.16 was reported.

A comparison of the January, 1889, pressure chart with that of the preceding month, shows that along a line traced irregularly from the south New England coast northwestward to Lake Superior, thence southwestward to the middle-eastern slope of the Rocky Mountains, and from that region west-southwest to the Pacific coast in about latitude N. 35°, the mean pressure was the same. To the northward of this line there was an increase in pressure, which was most marked on the north Pacific coast, and in the Canadian Maritime Provinces, where the mean readings were more than .10 higher than in the preceding month. To the southward of the line referred to there was a decrease in pressure, the deficiencies being greatest within an area extending from Kentucky south-southwestward to southern Alabama, where they exceeded .10.

Compared with the normal pressure for January, the mean barometer readings were above the normal on the Pacific coast north of the forty-third parallel and thence east and southeast over the Rocky Mountain regions to about the one hundredth meridian, the greatest departures above the normal being noted in western Montana and the upper valley of the Columbia River, where they exceeded .10. In all other sections of the country the mean pressure was below the normal, the deficiencies being most marked at stations in Ontario, Canada, along the Atlantic coast between the thirtieth and thirty-ninth parallels, and over portions of Alabama, Mississippi, and Louisiana, where they were more than .10.

BAROMETRIC RANGES.

The monthly barometric ranges at the several Signal Service stations are given in the table of miscellaneous meteorological data. The general rule, to which the monthly barometric ranges over the United States are found to conform, is that they increase with the latitude and decrease slightly, though somewhat irregularly, with increasing longitude. In January, 1889, the ranges were greatest over northeastern Michigan, where they exceeded 1.70. From this locality they decreased eastward to New England, where they were more than 1.50, and westward to Montana, where they were less than .80. From Montana the ranges increased to the northwestern part of Washington Territory, where they amounted to more than 1.10. Along the Atlantic coast the extreme ranges varied from .38 at Key West, Fla., to 1.57 at Eastport, Me.; between the eighty-second and ninety-second meridians, .57 at Cedar Keys, Fla., to 1.74 at Alpena, Mich.; between the Mississippi River and Rocky Mountains, .73 at Brownsville, Tex., to 1.40 at Saint Paul, Minn.; in the plateau and Rocky Mountain regions, .57 at Fort Grant, Ariz., to .95 at Salt Lake City, Utah; on the Pacific coast, .67 at Eureka, Cal., and .74 at San Diego, Cal., to 1.11 at Port Angeles, Wash.

AREAS OF HIGH PRESSURE.

Six areas of high pressure were observed during the month of January, 1889, three of which remained west of the Rocky Mountains over the plateau region, where they continued almost stationary from four to eight days, and afterwards disappeared by a gradual decrease of pressure and an apparent flow of cold air to the southern portions of the continent, resulting in the formation of areas of high pressure which moved to the Atlantic. Two areas of high pressure appeared over British America north of Montana and passed eastward over the Lake region, and thence over New England and the middle Atlantic

states. The general direction of movement of these areas was to the south of east until reaching the coast line, after which they inclined to the north of east. Areas of high pressure which formed over Texas and northern Mexico, although not directly traceable to the high area over the Rocky Mountain region, formed immediately after the Rocky Mountain area had reached its maximum pressure. These areas moved north-eastward from Texas to Nova Scotia, following the general direction of the coast line. One of the marked features of the month was the small number of areas of high pressure which passed over the country east of the Rocky Mountains and the prevalence of high areas over the northern plateau region which remained stationary during long periods, these two conditions resulting in abnormally high temperatures over the Northern States.

The following table exhibits, in a concise manner, some of the more prominent characteristics of the high areas:

No.	First observed.			Last observed.		Duration.	Velocity per h. r.	Highest pressure:		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Date.	Station.	Reading.
I.....	*27	46	115	42	110	Days. Miles.		*31	Helena, Mont.....	Inches. 30.94
II.....	9	27	100	42	72	12.5	2.0	13	Boston, Mass.....	30.42
III.....	11	54	111	42	61	4.0	21.9	13	Q'Appelle, N. W. Ter..	30.72
IV.....	17	54	99	49	60	9.9	25.0	19	Rockliffe, Ont.....	30.72
V.....	18	37	124	42	112	6.5	23.8	23	Boise City, Idaho.....	30.76
Va.....	21	45	99	44	60	9.5	17.1	23	New York City.....	30.64
VI.....	25	53	114	41	114	5.5	37.5	25	Q'Appelle, N. W. Ter..	30.90
Means.....						5.9	17.6			30.73

* December, 1888. † Also at several other stations in New England. ‡ During the first forty-eight hours this area moved at an average rate of 22.9 miles per hour after the 19th it had no decided movement. § During the first twenty-four hours this area moved at an average rate of 20.8 miles per hour, after which it remained practically stationary.

I.—The month opened with an area of high pressure covering the Rocky Mountains and plateau regions, where similar conditions existed during the last days of the previous month and which continued until the 8th of January without any decided change in the position of the area of high pressure. It did not develop sufficient energy to move eastward of the Rocky Mountains, and a gradual decrease of pressure was observed in these regions from the 31st of the previous month, when the maximum pressure was observed, until it finally disappeared.

II.—Number ii formed over the lower Rio Grande valley on the 9th, to the southwest of an area of low pressure of marked energy which was then central in the upper lake region. This area of high pressure moved over the Gulf States and thence northeastward along the coast. It was apparently reinforced by the cold air from the Missouri Valley, and by morning of the 13th it extended over the eastern portion of the United States, being central in New England, where the maximum pressure attending this area was observed. After the 13th this area apparently formed a part of high area number iii which was at that time central north of Dakota and extended eastward to the Saint Lawrence Valley.

III.—Number iii appeared in British Northwest Territory on the afternoon of the 11th, when areas of low pressure existed over the central Rocky Mountain region and off the north Pacific coast. It moved slowly eastward and southward, apparently forcing the areas of low pressure to the westward over the southern plateau region and southern California, causing general snows in the region between the Mississippi Valley and plateau region, and heavy rains in Texas. After reaching the region of Lake Superior on the 14th, when it covered three-fourths of the country to the east of the Rocky Mountains, it was apparently drawn to the southward, and on the 15th it was central over the middle Atlantic states, the weather maps for that day showing a gradual easterly movement of the area of high pressure and also of the low area which had formed over Lower California and Arizona. After

reaching the middle Atlantic coast the pressure increased rapidly at stations in Nova Scotia, which indicated the north-easterly movement of this area over the ocean. A decrease of pressure was observed at the centre of this area as it moved from the centre of the continent southeastward toward the coast, while in the preceding area there was an increase of pressure during the movement toward the same point from the southwest.

IV.—This area of high pressure was at no time central within the region of observation. It followed quickly in rear of an area of low pressure which passed with considerable energy over Lake Superior on the 16th, and was first observed north of Minnesota in Manitoba on the afternoon of the 17th. It moved eastward over the lower Saint Lawrence valley, causing a cold wave in New England and New York, on the 19th and 20th. After reaching the Saint Lawrence Valley it passed eastward over the Maritime Provinces, the pressure decreasing rapidly at the centre, in advance of the storm which was then in the Lake region.

V.—On the 18th this area of high pressure was apparently central west of central California. It first moved northward along the coast to Oregon and thence southeastward over Nevada to central Utah on the 20th, when it covered the greater portions of Nevada, Utah, New Mexico, and Colorado. It remained almost stationary during the succeeding twenty-four hours, contracting, however, and apparently supplying the cold air which formed high area number *va* in the lower Rio Grande valley on the morning of the 21st. After the formation of the last-named area the principal area moved northward, covering eastern Oregon and northern Nevada on the 22d, 23d, and 24th, the pressure increasing during the northwesterly movement, after which it disappeared as a distinct area and formed a part of high area number *vi* which appeared far to the north of Montana on the 25th.

Va.—Number *va* apparently formed in the lower Rio Grande valley on the 21st when killing frosts occurred in that region. It extended rapidly northeastward over the Southern and Middle States during the 22d, and on the morning of the 23d covered the greater portion of the United States east of the Mississippi River, the pressure increasing during the easterly movement, reaching its maximum while central off the middle Atlantic coast. Reports from the Maritime Provinces indicate that this area continued its northeasterly movement after leaving the coast line, but the pressure at the centre probably diminished after the area left the coast of the United States.

VI.—Number *vi* appeared far to the north of Montana on the 25th. It passed directly south to the central plateau region, a portion of the area apparently moving over the upper Missouri valley on the 26th, after which it united with the principal area which was central over Idaho on the 27th, where it remained almost stationary as a well marked area of high pressure, covering the Rocky Mountain and plateau regions, until the close of the month.

AREAS OF LOW PRESSURE.

Nine areas of low pressure were observed during the month of January, and those attended by storms over the United States east of the Rocky Mountains originated in low latitudes between Florida and southern California. Areas of low pressure having their origin in the Gulf of Mexico moved north-easterly, while those originating farther to the westward inclined more to the eastward. Two areas of low pressure were observed on the north Pacific coast, both of which disappeared either on the immediate coast or before crossing the Rocky Mountains. Two areas of low pressure developed in British America north of Dakota or Montana, one of which passed over the upper lake region, attended by general snows throughout the adjoining states, while the other passed to the north of the Lake region, causing but slight changes in the weather conditions within the United States.

The following table exhibits the principal facts regarding these low areas:

No.	First observed.			Last observed.			Duration.	Velocity per h.r.	Lowest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.				Date.	Station.	Reading.
I.....	3	26	90	45	65	Days.	Miles.		7	Yarmouth, N. S.	29.24
II.....	5	53	115	50	89	4.5	18.5		7	Fort Garry, Man.	29.48
III.....	7	33	101	52	60	2.0	25.0		7	Alpena, Mich.	28.82
IV.....	10	50	124	42	103	3.5	31.0		9	Olympia, Wash.	29.65
V.....	11	47	130	45	123	1.0	50.0		10	Portland, Oregon.	29.60
VI.....	13	32	119	52	70	1.0	16.7		12	P. Arthur's Landing, Ont.	28.94
VII.....	19	34	104	50	59	4.5	27.8		16	Anticosti, Gulf of St. L.	29.22
VIII.....	19	25	98	42	71	3.0	36.1		22	Eastport, Me.	29.42
IX.....	26	34	79	46	68	1.5	58.3		28	Saugeen, Ont.	29.54
IX.....	29	52	100	46	75	2.0	39.6		31	29.37
Means.						2.9	40.4				

I.—The month opened with generally fair weather which continued until the 3d, when this storm was observed in the Gulf south of New Orleans. On the morning of the 4th it was well defined and central east of New Orleans, attended by general rains throughout the Gulf States. It passed over the south Atlantic states to the middle Atlantic coast, where it was central on the morning of the 6th, the pressure decreasing rapidly during the northeasterly movement. Dangerous gales occurred on the New England and middle Atlantic coasts for which warning signals had been displayed, the wind reaching a maximum velocity of seventy miles per hour at Block Island, R. I., and forty-four miles per hour at Boston, Mass., on the 6th. These gales continued with less force during the 7th, except at Eastport where a maximum velocity of forty-eight miles per hour occurred during that day. This storm apparently attained its maximum energy when its centre was near Yarmouth, N. S., on the 7th, after which the pressure increased at the centre and the barometric gradient became less as the storm passed to the northeast of the Maritime Provinces.

II.—Number ii appeared as a feeble depression to the north of Montana on the 5th, and during the two succeeding days it moved eastward to north of Lake Superior, attended by snows at northern stations. After reaching Lake Superior it could no longer be traced as a separate area, owing, probably, to the rapid advance of a storm from the southwest which covered the central valleys on the 8th.

III.—Number iii was the most remarkable storm of the month, owing to the great energy it developed while passing over the central and northern portions of the United States; and the violent local storms which occurred in its southeast quadrant, while the centre was passing from the Mississippi Valley toward Lake Huron, resulted in great loss of life and property. It was first observed as a slight disturbance central in Texas on the afternoon of the 7th, and by the afternoon of the 8th it covered the central valleys, being central near Cairo, Ill., its general form being that of an ellipse with its longer axis pointing directly northward. On account of the unusual violence of the numerous local storms which attended this disturbance, the Signal Service weather maps of the 8 a. m. and 8 p. m. telegraphic reports of the 9th are published with this REVIEW, the charts exhibiting lines of equal barometric pressure, isothermal lines, direction of wind, and the track of the general storm for the hours named, from which may be determined the approximate position of the storm-centre at the hours when the severe local storms occurred. During the 9th, when this storm was most destructive in the middle Atlantic states and Lake region, its centre was passing almost directly northward from southwest Michigan to the northern portion of Lake Huron. After leaving the Lake region its course changed and inclined more to the eastward, disappearing to the northeast of the Gulf of Saint Lawrence on the afternoon of the 11th. The following special reports received from Signal Service and voluntary observers and from other sources are of interest:

Toledo, Ohio, 9th: at 11 a. m. the wind blew from the southwest at the rate of thirty-six miles per hour; it increased in force until 11.35 a. m., and from that time until 7.30 p. m. blew at the rate of forty-eight miles per hour, the maximum velocity being fifty-five miles per hour; after 7.30 p. m. the wind

decreased in force. No serious damage occurred. The water in Maumee River was lower on this day than ever before known, the river bed from the the Ohio Central dock to Pennsylvania bridge being entirely dry during the storm.

Pittsburgh, Pa., 9th: a violent gust of wind from the southwest set in at 12.30 p. m., increased in force until 12.44 to 12.46 p. m., when a velocity of forty miles per hour was registered, and ended at 1.35 p. m. During the height of the gale the wind-vane oscillated violently, and several times described a complete circle. The storm was apparently a violent gale, having none of the characteristics of a tornado. An unfinished structure of seven stories was completely demolished, carrying with it in its fall portions of other buildings. Forty-nine persons were injured and fifteen killed. An unfinished building in another portion of the city was also wrecked and one man killed. About twelve buildings in Allegheny City and Pittsburgh were unroofed or otherwise damaged; estimated loss from the storm, \$165,000.

Harrisburg, Pa., 9th: light and heavy rain fell at intervals, with light south to east winds up to 4.13 p. m., at which time the wind changed suddenly and blew from the west with great violence. The severest part of the storm occurred at 4.18 p. m., at which time the anemometer cups, with attachment, were carried away by the wind, hence the maximum velocity of the wind can only be estimated, and must have reached fully one hundred miles for two or three minutes. Much damage was done to property, shade trees, telegraph and telephone wires, and the streets were strewn with roofs, awnings, and debris of various kinds. The storm, which came from due west, struck the Susquehanna River, sweeping the water up in a wave thirty feet high. At that time the barometer was observed very closely and was actually seen to take a sudden upward jump of 0.2 of an inch: the wind continued high into the night and the rain ceased at 5.40 p. m. The storm was preceded by high temperature and a distinct roar like distant thunder.

Reading, Pa., 9th: a cyclone visited the northern part of this city this evening about 5.40 o'clock, and its track was marked by a series of terrible disasters seldom equalled in the history of such visitations. The cyclone lasted but a moment; it swept across the city from west to east, unroofing factories, mills, and houses, uprooting trees, and overturning nearly everything in its course. The large paint shops of the Philadelphia and Reading railroad were demolished, and in a moment the combustible materials contained therein were a mass of flames. A few squares from there it struck the Reading Silk Mill, a large, new five-story building in which some 300 girls and boys were working, and crushed the huge building like an egg-shell before a single person could escape. The building was leveled to the foundations and all the people went down in the midst of a great heap of beams, bricks, and twisted machinery. The path of the cyclone was from 60 to 100 feet wide, and it was fortunate that it passed through a portion of the city that was not entirely built up, else the loss would have been well-nigh incalculable. As it is, its path is strewn with wreckage. The Mount Penn Stove Works were unroofed and considerable damage done to the building. The cyclone struck the large nut and bolt works of J. H. Sternberg & Son with great force, carrying away the immense roof of the main building. On North Ninth street it cut a clean swath through a row of new houses, unroofing nine of them. The storm's actions were most peculiar. In many cases the damage done was such as would be accomplished by an ordinary high wind, but in others it seemed to crush from above. This was notably the case at the silk mill. Witnesses of its demolition say that the building went down all in a heap as if a huge weight had dropped upon and smashed it. A curious circumstance is that the high stack of the mill, which was at one corner, is still standing, and is not even shattered.—*The (Philadelphia) Press, January 10th.*

"The (Philadelphia) Times" of the 11th gives the number of persons killed by the Reading storm as forty.

Philadelphia, Pa., 9th: at 8.30 a. m. the wind changed to southeast and the rain was renewed, lasting until 1.45 p. m. A few minutes before 10 a. m. there was a sudden fall of 0.1 inch in the barometer within five or ten minutes. The barometer reached its lowest point, 29.15 (actual), at 6.15 p. m., when it began to rise rapidly; the wind at this hour veered to the northwest, and at 6.40 p. m. the temperature fell almost instantly 13°—from its maximum to nearly its minimum. At this time the storm passed the eastern edge of Camden, N. J., and caused damage over an area of less than five blocks, amounting to \$5,000. The whirlwind came from a southwesterly direction and moved to the northeast; eight houses were unroofed and numerous fences demolished. The storm took a course across some vacant lots, where the force of the wind was well illustrated, a large section of an ice-house roof having been carried east across the railroad and thrown against a row of brick houses. The whole front of one building was crushed in and that of another was badly damaged. There was no loss of life. During the passage of the tornado rain fell in torrents.

East Brady, Clarion Co., Pa., 10th: a terrific hail storm passed over this place at 2 o'clock yesterday. The storm was the most violent here in years.—*Leader, January 10, 1889, Pittsburgh, Pa.*

Buffalo, N. Y.: the storm which began during the forenoon of the 9th continued throughout that and the following day; the high wind caused the heavy falling snow to drift badly and the debris of outhouses, skylights, parts of roofs, fences, etc. were strewn over the streets, detaining the street cars several hours. The actual velocity of the wind was seventy-eight miles per hour at 7.26 a. m., 10th, and the average hourly velocity for forty-eight hours was 49.1 miles. The lake which was free from ice rose 7.8 feet above high water mark, flooding the Island during night of 9-10th and rendering its entire population, about twenty families, homeless. The New York Central Railroad track near Porter avenue was completely washed out as well as the

"Belt line" route. The gale was the severest experienced since the establishment of the Signal Service station in 1870.

Humphrey, Cattaraugus Co., N. Y., 9-10th: at 4.30 p. m. the wind changed from southeast to southwest and began to blow a gale which increased during night and continued until 9 a. m., 10th, unroofing buildings; numerous oil-derricks were blown down twenty miles south of this place.

Mr. William A. Eddy, of New York City, makes the following report relative to the storm which visited Brooklyn, N. Y. on the 9th: "Brooklyn, N. Y., January 9, 1889, 7.40 p. m. (seventy-fifth meridian time); course of storm from southwest to northeast, but along a decidedly northerly course; width of path five hundred to six hundred feet; length of path, two miles at least; velocity of storm, fifty to sixty miles an hour; shortest time in passing a given point, ten seconds; form of cloud not seen, owing to darkness; direction of whirl in cloud, right to left, or against the motion of the hands of a watch; temperature preceding storm, not ascertained; temperature following storm, not noticeably cooler; direction of destructive winds, from the southwest; rain just before; no hail; characteristics of formation of cloud not observed, owing to darkness; no electricity in cloud and no thunder. It first struck a new building in South Brooklyn, facing the open water in Gowanus Bay, and its roaring was heard ten or fifteen minutes in advance of its arrival. After striking the building it remained near enough to the ground to lift here and there a roof, or to blow down fences, and created strong earth currents that caused some trifling damage. The funnel did not approach very near the ground, however, until it reached some gasometers of the Citizens' Gas Co., when it lifted the gasometer nearest the southwest approach of the tornado track. The iron pillars, not less than two feet in diameter and perhaps forty feet high, were thrown principally in a northerly direction, one or two of those nearest the tornado track being thrown in a westerly direction, thus showing clearly enough the whirl of a tornado. The funnel then bounded into the air and exerted severe local currents here and there near the ground, in some cases the ground currents being strong enough to break large plate-glass windows. It was thought at first that this breakage of large windows was due to the explosion of the gasometers, but an examination in other directions aside from the tornado track revealed that no windows at like distances were broken. A number of roofs, chimneys, and bits of upper brick work were torn off, now and then, as the funnel here and there dipped a little lower. This variation of lighter destruction, principally in the upper parts of buildings, continued for nearly two miles. When the tornado came within about one-fourth of a mile from the Navy-Yard it began to descend toward the earth, taking off not only some roofs but several feet of brick wall, the bricks of which and of chimneys were mostly never found. It then lifted for another stretch, perhaps one-eighth of a mile, and passed over one building with a high cupola before descending upon the Navy-Yard gate leading to the Marine Barracks. It tore down a high tree about three feet in diameter at the left of the gate, throwing the tree west of north. The suction upon the double gate leading to the barracks was so strong that an inner gate of the two was torn out and thrown north and west, its huge hinge before giving way partly turning round a large stone pillar supporting the masonry of the structure, which is a sort of porter's lodge with rooms in the upper story. A curious result of this, showing powerful suction, was that the outer of the two gates was not injured. In the barracks the structure was torn away for a length of about five hundred feet. The walls of brick were not destroyed lower than ten or twelve feet from the ground, except by leverage of timbers or debris in motion. The roof of the barracks and its timbers were mostly ground into pieces, some fragments, however, being as much as ten feet square. Most of the brick work seemed to have disappeared. The timber and roof fragments remaining were scattered in a half circle, first northerly, then westerly, then southerly back against the barracks. One of the largest pieces of roof cut this circle, followed part of the way around by smaller fragments. Some of the tin roof was carried a long distance northeast, then west, and scattered into fragments which were rolled into wads. The fragments from the barracks did not seem to be scattered in very great quantities along the northeast course of the tornado, many of them, however, seemed to have disappeared. After leaving the barracks the tornado track led over the East River, and there vanished as far as I know at the present writing. It seems probable, from conditions observed, that a funnel might have moved high in air over New York City."

The Signal Service observer at New York City reports, "that high southeasterly winds prevailed during the day of the 9th, shifting to westerly during the evening and increasing in force. At about 7 p. m. the clouds assumed a tornado formation, which, passing over the city, struck South Brooklyn with great violence, unroofing houses, completely demolishing several, and blowing down fences and trees. It was also the direct cause of an explosion of one of the largest gas tanks in Brooklyn. This loss is estimated at \$200,000. The tornado moved from south to northeast; its path was well-defined, and houses were unroofed over its entire course. The damage will probably reach \$500,000."

The telegrams issued as warnings to land stations and to the lake and sea-ports in advance of this storm are as follows:

WASHINGTON, D. C., January 9, 1889.

To observers: Norfolk; Norfolk section; Fort Monroe; Baltimore; Breakwater; Atlantic; Sandy Hook and New York.

Hoist storm southeast at 10.15 a. m. Severe storm, central near Chicago, moving northeast. Southeast winds, with rain, followed Thursday by westerly winds and much colder, clearing weather.

GREELY.

WASHINGTON, D. C., January 9, 1889.

To observers: Jacksonville; Jacksonville section; Savannah; Savannah section; Charleston; Wilmington; Wilmington section; Morehead City.
Hoist cautionary southwest at ten fifteen a. m. Storm-centre near Chicago, moving northeast. Winds veering to westerly with much colder, clearing weather.

GREELY.

WASHINGTON, D. C., January 9, 1889.

To observers: Norfolk; Norfolk section; Fort Monroe.
2 p. m., change to storm southwest. Storm-centre near western Lake Erie, moving eastward. Winds veering to westerly with colder, clearing weather.

GREELY.

WASHINGTON, D. C., January 9, 1889.

To observers: New Haven; New London and Newport section; Narragansett section; Wood's Holl section; Boston, Boston section; Portland; Portland section.

Hoist storm southeast at two fifteen p. m. Storm-centre near western Lake Erie, moving eastward. Heavy rain, warmer and high southeast winds, followed Thursday by clearing, much colder and high westerly winds.

GREELY.

WASHINGTON, D. C., January 9, 1889—3.10 p. m.

To observers: New York; New Haven; New London; Newport section; Narragansett section; Wood's Holl; Wood's Holl section; Boston; Boston section; Portland; Portland section; and Secretary Maritime Exchange, New York.

The storm-centre over Lake Erie is increasing in intensity and moving nearly due east. It is accompanied by violent local winds which may possibly continue as it moves eastward.

GREELY.

WASHINGTON, D. C., January 9, 1889.

To observers: New Orleans; Mobile; Pensacola; Cedar Keys.
Change storm to cautionary northwest, and signal down at sunset. Storm centre near Chicago, moving northeast. Colder, clearing weather.

GREELY.

WASHINGTON, D. C., January 9, 1889—9.02 p. m.

To observer: Eastport.
9.05 p. m. Hoist storm southeast. Severe storm central over Lake Huron, moving eastward. Heavy rains with southerly winds shifting to westerly during Thursday.

GREELY.

IV and V.—Numbers iv and v appeared on the north Pacific coast on the 10th and 11th, respectively, and after developing considerable energy were forced to the southward and westward by an extended area of high pressure, and both disappeared without passing to the eastward of the Rocky Mountains. The movement of these areas is shown on chart i.

VI.—This was the only storm of the month which passed from the Pacific coast eastward to the Saint Lawrence Valley. It was probably central near San Diego, Cal., on the morning of the 13th, after which it moved slowly over southern California, Nevada, Utah, and western Colorado, where it was central on the 15th. After the morning of the 15th the easterly movement became accelerated and by morning of the 16th the storm was central in southern Minnesota. It increased in force as it passed over Lake Superior, the barometer reaching the minimum on the afternoon of the 16th, at Prince Arthur's Landing, when the centre was near that station. The area of precipitation included the whole country east of the Rocky Mountains, the rains being very heavy in the Gulf States,

Tennessee, and the Ohio Valley. Westerly gales were severe in the Lake region, and the wind attained maximum velocities ranging from forty to fifty miles per hour along the middle Atlantic and New England coasts on the 17th, when the centre was passing from the Lake region to the Saint Lawrence Valley.

VII.—This storm was first observed as central in eastern New Mexico on the 19th, but the reports of the preceding day showed that an extended barometric trough covered the central Rocky Mountain region and on the 17th an area of low pressure appeared on the north Pacific coast. As this barometric trough moved eastward two distinct centres of disturbance were observed, one over the Gulf, and the other in the central Mississippi valley on the 20th. The disturbance farthest northward moved over the Lake region while that in the Gulf moved along the south Atlantic coast, and the two united in southern New England, causing dangerous easterly gales which were followed quickly by winds shifting to westerly during the 21st, as the storm passed northeastward as a single disturbance. The strongest gales occurred on the northern New England coast, the wind reaching a velocity of sixty-four miles per hour at Eastport, Me., on the 21st. The pressure continued to decrease during the northeasterly movement and gales continued at northern Maritime stations on the 22d.

VIII.—From the 22d to the 25th an area of low pressure existed over the Rio Grande Valley and west Gulf, but the reports were not sufficient to justify the location of the centre of disturbance until the morning of the 26th, when it was near, and to the west of, New Orleans. General rains prevailed throughout the Southern States and light snows in the upper lake region and Northwest; a second depression was central in the Lake region and a cold wave in the Missouri Valley. This storm moved rapidly towards the Ohio Valley while a secondary disturbance developed on the south Atlantic coast, both moving northeastward over parallel lines until they reached northern New England where they united and the pressure reached its minimum. The rains were generally heavy in the Southern States and Ohio Valley, and the storms were followed quickly by a cold wave which caused snow as far south as the Gulf States. The snow being light, it quickly disappeared, leaving the ground generally bare to the south of the fortieth parallel. After these two storms united the resulting disturbance was feeble, and it was difficult to trace its movements after the union.

IX.—This storm appeared north of Manitoba on the 29th and moved southeastward to Wisconsin, causing general snows in the Lake region, Minnesota, and Dakota, on the 29th and 30th. After reaching the Lake region the barometer continued to fall at the centre and the direction changed to the eastward, the storm centre passing over Lake Huron, after which it passed to the Saint Lawrence Valley where it was central at the close of the month.

NORTH ATLANTIC STORMS FOR JANUARY, 1889 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during January, 1889, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels, received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Eight depressions have been traced, of which four were continuations of storms which first appeared over the American continent; two apparently developed over mid-ocean; one is given a probable track eastward from off the Labrador coast, and one moved east-northeast from the vicinity of the Bahamas, over or near Bermuda, and disappeared over the ocean west of the Azores. The depressions pursued normal east-northeast to northeast tracks, except number 1, which assumed a southerly course over mid-ocean, and number 7,

which passed southeastward over Newfoundland during the 18th and 19th. But one storm is traced over the ocean south of the forty-fifth parallel, although three depressions advanced along the immediate coast of the United States. Over the eastern part of the ocean generally fair weather prevailed, except from the 7th to 16th, inclusive, when low and fluctuating pressure and gales of varying force were reported. Over mid-ocean unsettled weather prevailed during the first two decades, while during the last ten days of the month the pressure continued generally high, and no storms of marked violence were noted. To the westward of the fiftieth meridian stormy weather prevailed from the 1st to 3d, 6th to 13th, 18th to 22d, and 28th to 30th.

In January, 1888, nine depressions were traced, of which six advanced eastward from the American continent north of the fortieth parallel; one developed over mid-ocean between the